

DAIKIN



CRYOTEC
Cryogenic technology

2Stage 4K Cryocooler System

UV210SGWUC

Operation Manual

Warranty
<p>Daikin warrants this cryo-cooler and helium compressor for a period of one year from the date of delivery. Service and replacements for troubles attributable to Daikin shall be free-of-charge during this period.</p> <p>However, this warranty does not apply in the following case.</p> <ul style="list-style-type: none">(1) When the equipment has been operated or serviced in ways not specified in this operation manual(2) When the equipment has been used under unusual conditions without Daikin's agreement.(3) When the equipment has been disassembled, modified or remodeled without Daikin authorization

FOR YOUR SAFETY








(Read this section BEFORE using the equipment.)

This manual uses the following important precautions.

WARNING : Means that mishandling could result in serious accident or even death.



CAUTION : Means that mishandling may have serious consequences depending on the situation.

Observe both types of precautions at all times. Also, keep this manual handy for future reference.

 <p>WARNING</p>	<ul style="list-style-type: none"> ◆ Use only a proper specification cable to connect the power supply. Allow only a qualified electrician to perform electrical wiring work. ◆ NEVER make electrical checks on live or exposed parts. If unavoidable, entrust checks to a qualified electrician. Failure to observe this warning could result in accident or even death due to electric shock. ◆ The compressor unit is filled with helium gas. Before disassembling, exhaust gas until reaching atmospheric pressure. However, this is not necessary when only disconnecting the connecting hoses or removing the adsorber. Unless pressure is down to be level with the atmospheric pressure, all persons in the immediate area are in DANGER. 	 <p>ELECTRIC SHOCK</p>
	<ul style="list-style-type: none"> ◆ During use, the surface of the compressor cover is HOT in spots. Before performing maintenance, stop the compressor unit and cool to room temperature (leave for approx. 30 minutes) so as to avoid burns. 	 <p>HANDLE WITH CARE</p>
	<ul style="list-style-type: none"> ◆ NEVER heat the connecting hoses or other parts when pressurized. Always wear safety goggles when handling pressurized parts. 	 <p>HOT</p>
 	<ul style="list-style-type: none"> ◆ Before disconnecting the pressurized helium gas lines, turn off the compressor unit and allow expander to warm to room temperature. If pressurized helium gas lines must be disconnected when at cryogenic temperature, contact the qualified manufacturer. ◆ Do not charge gas if the gas charger is not equipped with a suitable regulator. Overpressure can damage the system and cause accidents. 	 <p>HANDLE WITH CARE</p>

CRYOTEC

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1. STANDARD SPECIFICATIONS

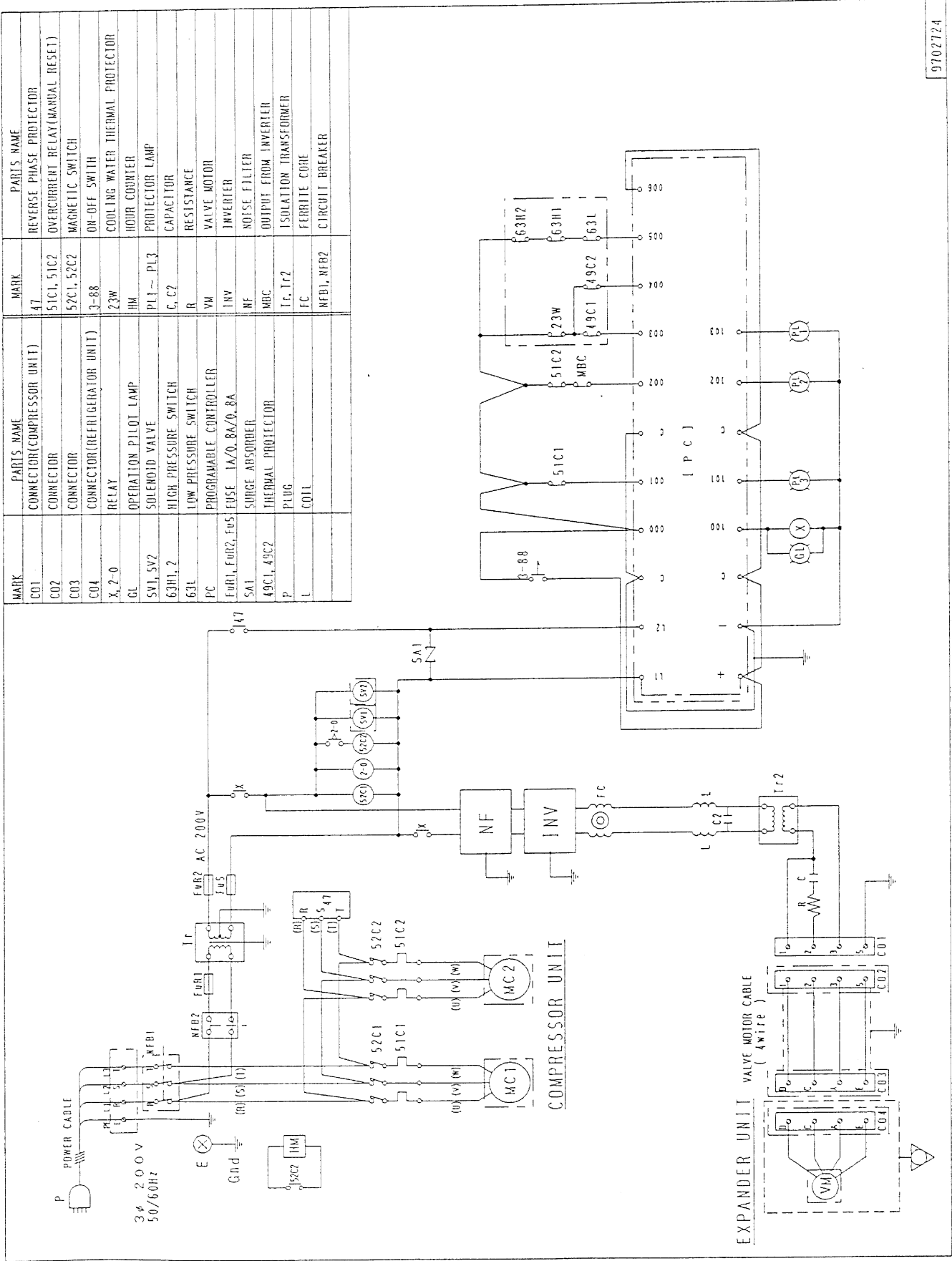
1.1. Specifications

Model	UV210SGWUC	
Item		
Expander unit model	V210CSG-UCM	⚠
Compressor model	U110DW-UCM	⚠
Connecting hose type	H204SCLL-UC (10m)	
Cooling capacity (60Hz)		
• First stage (35W)	41K	
• Second stage (0.8W)	4.2K	
Electrical characteristics (50/60Hz)		
• Power supply	3-phase: 200V ("Y" configuration)	
• Power consumption	5.3 / 6.7 kW	
• Starting current	76 / 71 A	
• Operating current during normal operation	18.5 / 22 A	
Cooling water		
• Flow rate	6.5 to 8.0 L/min.	
• Head loss*1	50 to 80 kPa (5 to 8mH ₂ O)	
• Inlet pressure range	0.7 Mpa (7kgf/cm ² G) or less	
• Inlet temperature range	4 to 28°C	
Refrigerant	99.995% helium gas (Dew-point: -62°C)	
Refrigerant charging pressure	1.91 ± 0.098 Mpa (19.5 ± 1.0kgf/cm ² G) at 20°C	⚠
Operating pressure (normal operation)		
• Outlet pressure	2 to 2.5 Mpa (20 to 25kgf/cm ² G) *2	
• Inlet pressure (reference)	0.5 to 1.0 Mpa (5 to 10kgf/cm ² G) *2	
Ambient temperature for installation	4 to 38°C	
Maintenance interval	Expander unit: 9,000 hours Compressor unit: 30,000 hours	
Weight		
• Expander unit	16 kg	
• Compressor unit	115 kg ⚠	
Protection against electric shock	Class I, Type B	⚠
Protection against harmful ingress of water	Ordinary	
Safety of application in the presence of a flammable anaesthetic mixture with air or with oxygen or nitrous oxide	Not suitable	
Mode of operation	Continuous	

NOTE



Using flow rates above the cooling water standard will cause erosion in cooling water hoses and eventually lead to leaks. In particular, this can occur in a comparatively short amount of time with transient cooling water that has a high level of dissolved oxygen. Therefore, it is recommended to control water quality.

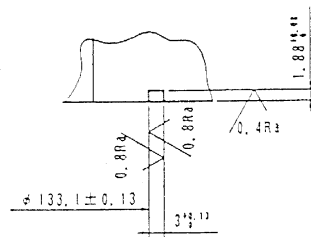
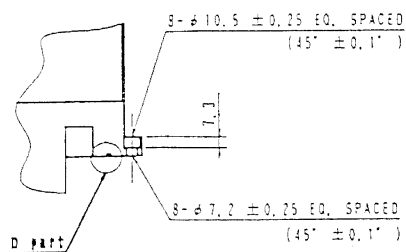
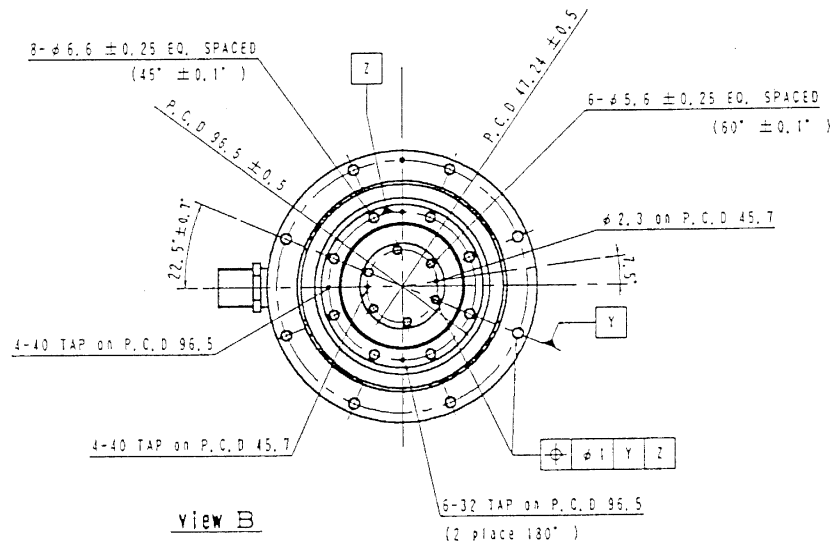
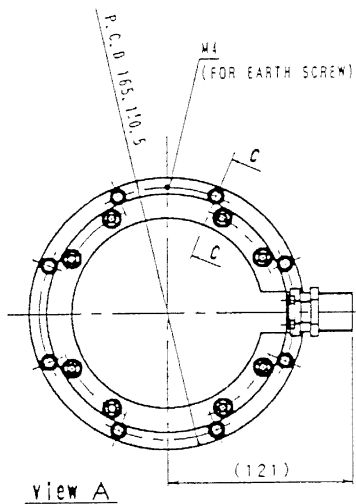
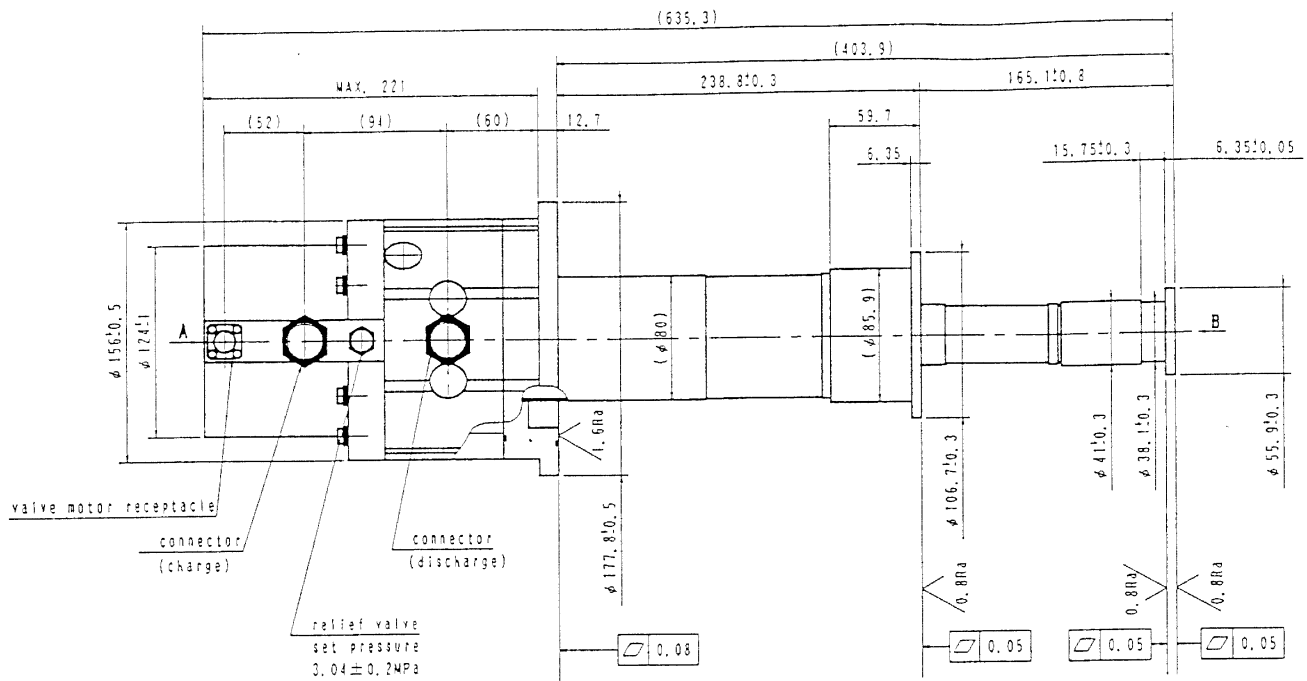
1.3. Electrical Wiring Diagram ⚠ ⚠ ⚠



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1.2. External Dimensions

<Expander unit>  

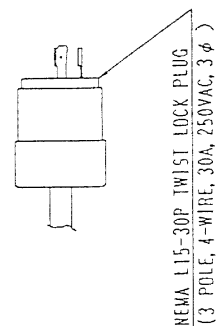
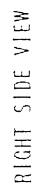


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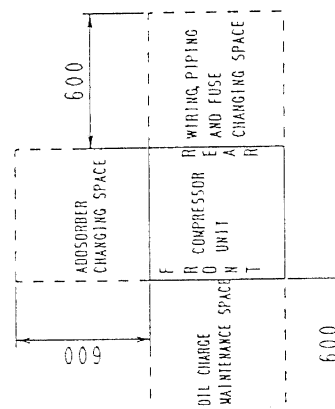
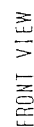
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MANIFOLD WITH DIFFERENTIAL PRESSURE CONTROL VALVE

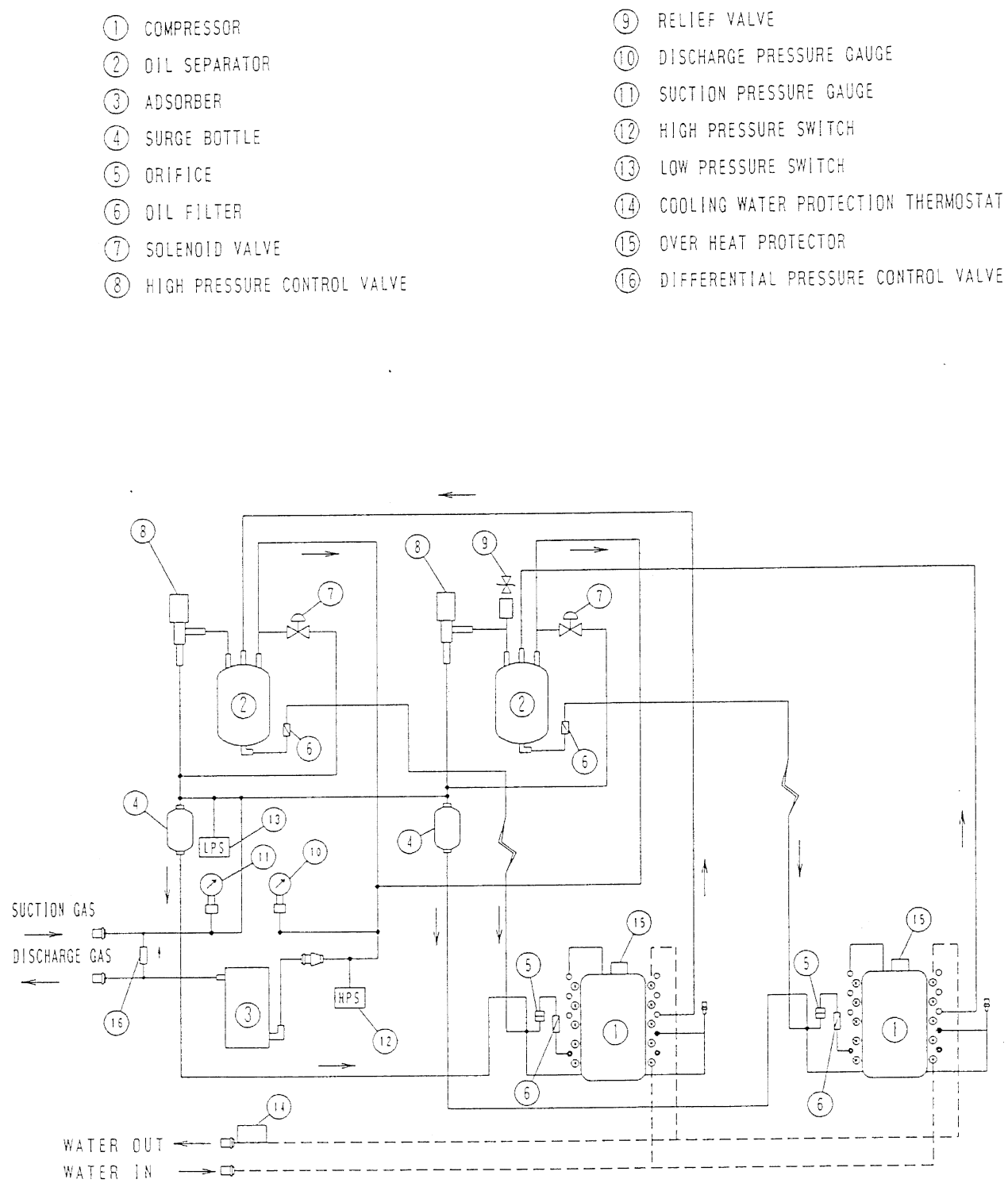


DETAIL OF POWER CABLE END



MAINTENANCE SPACE

1.4. Flow System Diagram (Compressor unit)



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2. COMPONENTS

Field connections

(Before making connections, make sure to read the FOR YOUR SAFETY section.)

- 1) Connect expander unit and compressor unit with connecting hoses, respectively to high-pressure/low-pressure ports.

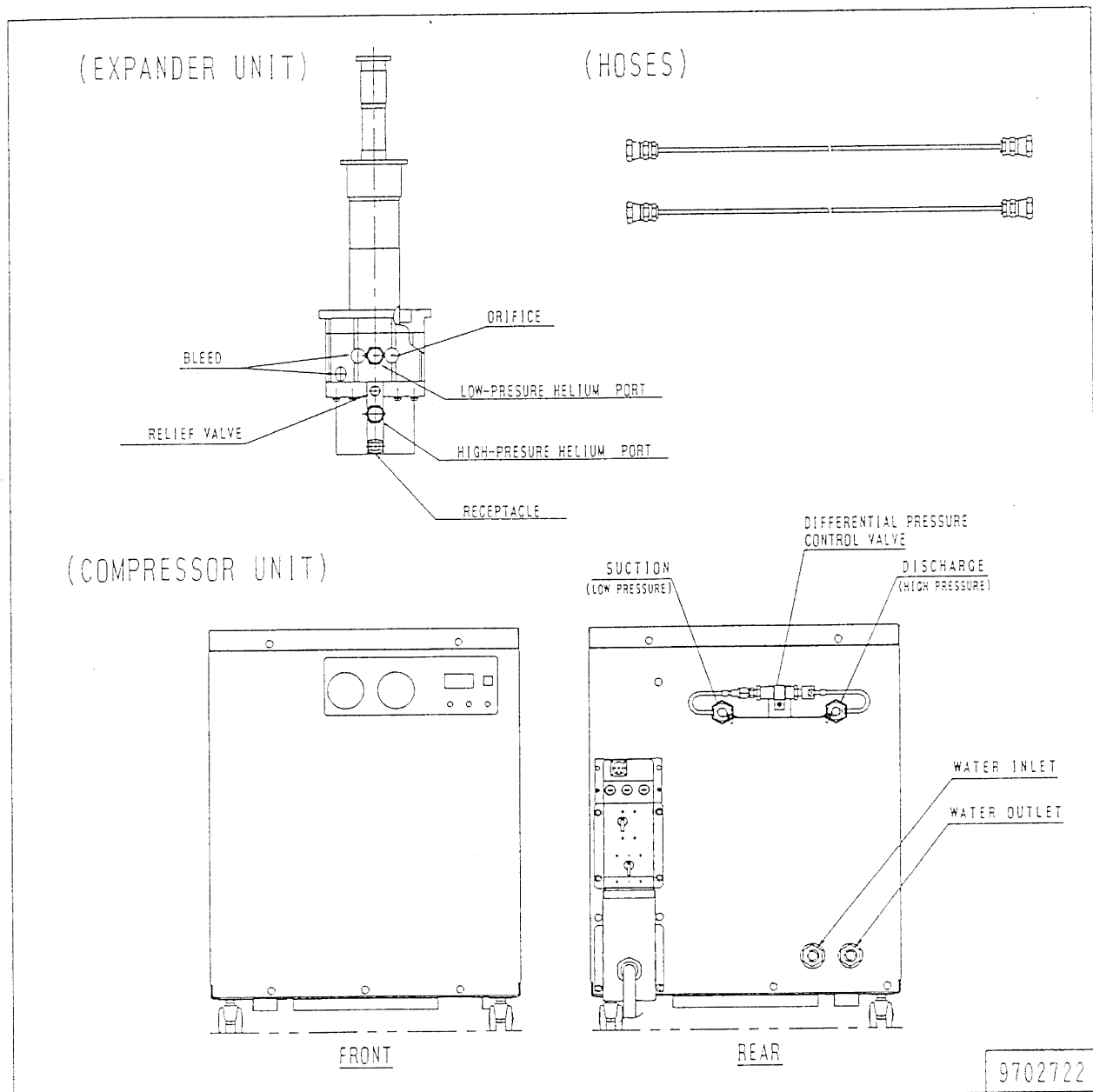
(The high pressure port is red whereas the low pressure port is green sticker.)

- 2) Connect expander unit and compressor unit with transmission cable.

(Fit the connector into the receptacle.)

- 3) Connect a power supply to the compressor unit.

- 4) Let in cooling water and circulate it through the compressor unit.



3. NAMES AND FUNCTIONS OF PARTS

3.1. Expander Unit

1) Cylinder assembly

Valve motor assembly and displacer assembly have been removed from the expander unit, therefore the cylinder has only the displacer on the inside. the displacer follows a reciprocating motion.

2) Displacer

The displacer is composed of a first-stage displacer, second-stage displacer, slack piston and the coupling and seal rings to connect them.

3) Valve stem

The valve stem is mounted on the motor base and surface-contacts to the valve disk. The contacting surface is particularly important and is processed with special care.

4) Valve disk

The valve disc is attached to the motor shaft. It surface-contacts to the valve stem under high gas pressure and spring force. Valve disk rotation switches the circuit between the high pressure port and displacer, and between the displacer inside and the low pressure port. During this time, the displacer follows a reciprocating motion.

5) Valve motor assembly

Valve motor parts include the motor housing, valve motor and motor base. The valve motor turns the valve disk.

3.2. Compressor Unit (See page 5.)

1) Compressor

The compressor is exclusively designed for use with helium gas. Helium gas has a high adiabatic exponent. It becomes hot when compressed, so the compressor is cooled down using cooling water.

2) Oil separator

The oil separator separates and collects refrigerating machine oil mist from the compressed helium gas. Refrigerating machine oil that accumulates in the oil separator is returned to the compressor through the capillary tube connected to the low pressure line. Differential pressure allows the oil to flow back to the compressor.

3) Adsorber

The adsorber removes refrigerating machine oil which is not collected by the oil separator so that clean (pressurized) helium gas is fed to the expander unit. The refrigerating machine oil collected in the adsorber is held inside, therefore shall be replaced after certain period; normally every 30,000 hours of operation. The replacement procedure is explained in the page 18.

4) Surge bottle

The surge bottle is attached to the compressor suction line. It suppresses pulsation in the suction gas so that gas fed to the compressor is in stable pressure.

5) Orifice

The orifice regulates the amount of oil injected into the compressor.

6) Oil filter

Filters are attached to the high pressure side of each the capillary tube (used to return refrigerating machine oil from the oil separator to the compressor) and the orifice (used to regulate refrigerating machine oil injection). They protect the system against foreign matter.

7) Solenoid valve

The solenoid valve equalizes high-low pressure while the compressor is not running. This prevents refrigeration oil in the compressor from backflowing to the low pressure side, and reduces load at pump start-up. It is closed while the compressor is running.

8) Pressure regulator

The pressure regulator is attached to the piping that links the high and low pressure sides. When system operating pressure is high, as is the case at start-up, the regulator bypasses high pressure helium gas to the low pressure side, thus keeping pressure under a certain limit. This maintains stable operating conditions.

9) Relief valve

The relief valve release gas into the atmosphere when system operating pressure is abnormally high.

4.2. Operation When Trouble Occurs

- The compressor unit will stop automatically if power is lost or if trouble occurs. In such case, it is necessary to locate and eliminate the cause. If unable to identify the cause, contact a service operator.
- 1) If the compressor overheat protector or cooling water protection thermo trips (OL lamp is lit.), check cooling water temperature and flow rate.
- 2) If the high pressure switch or low pressure switch trips (H/LPS lamp is lit.), check if connecting hoses are properly connected and refrigerant charging pressure is normal.
- 3) If the overcurrent protector trips (OC lamp is lit.), check the power supply voltage.

Note: When trouble of inverter is happened ,OC lamp is lit ,too .

If the power source is normal ,please inform service company or our agent .

4.3. Notes on Compressor Unit Electrical Wiring Work

- Always shut OFF power supply and disconnect a power supply to the compressor unit before connecting the valve motor cable between the compressor unit and expander unit.
- During operation, voltage across expander unit terminals is over 200 V. Use caution in handling.
- ⚠ ● It is recommended to fit the primary power supply with a leakage breaker.
[Use a minimum 30 A breaker . Ensure trip current is approximately 15 mA and a supply cord of $4 \times 4\text{mm}^2$ diameter.]

4.5 Setup the workbench pad and maintenance tools. Place glove bag on the work pad.

Place following items into the glove bag;

- * Replacement cryocooler(parts)
- * Piston puller
- * 5 mm Allen wrench
- * 2x#8F Charge / Vent adapters
- * 1/4 Φ x12"lg.copper tube
- * 1/2 Φ x12"lg.Plastic tube
- * Lint-free wipes
- * Flashlight

4.6 Connect the helium gas charging line from the helium gas bottle to the glove bag. Set the helium gas flow by adjusting pressure regulator to achieve a low purge flow. Purge the line then close the helium gas purge valve inside the glove bag.

4.7 Turn off the compressor. Record the equalization pressure.

4.8 Disconnect the expander cable from the used cryocooler valve motor receptacle.

4.9 Disconnect the SUPPLY and RETURN gas lines from the used cryocooler.

4.10 Connect the charge/vent adapter to that used cryocooler gas SUPPLY coupling and vent -1/2 of the helium gas charge. Do not vent zero.

4.11 Remove 4 of the 8 valve bolts from the used cryocooler; remove every other bolt so that the remaining (4) bolts are evenly spaced. Keep the used cryocooler pressurized with helium gas.

4.12 Place the charge/vent adapter back into the glove bag.

4.13 Place the open end of the glove bag over the cryocooler valve motor assembly and down around the circular cryocooler cryostat mounting base. Wrap the bungy cord around the cryocooler warm flange making sure the open end of the glove bag is sealed. Secure the ends of the bungy cord. Below the bungy cord, wrap duct tape over the glove bag to seal around the cryocooler cryostat mounting port.

or condensation (excessive clouding or ice crystal on cylinder walls). Remove all contamination or condensation from the inside cylinder walls.

4.26 Attach line-free wipes on the end of a 1/2" Φ x 12" lg. plastic tube and clean the inside surfaces of the cylinder wall. Use the helium gas purge wand to blow out contaminants. If contaminants can not be removed, the heater block procedure must be used.

4.27 Disassemble the replacement cryocooler. Remove the valve motor assembly and set to the side inside the glove bag. Using the piston puller, remove the new displacer from the replacement cryocooler and immediately install into the cylinder assembly. Apply force to bottom the displacer into the cylinder.

4.28 Install the new O-ring at the cylinder warm flange.

4.29 Assemble the replacement valve motor assembly to the cylinder.

4.30 Install and hand-tighten all (8) valve motor bolts.

4.31 Remove the glove bag.

4.32 Torque valve motor bolts evenly to 9.8 N-m (100 Kgf-cm)

4.33 Connect helium gas line between helium gas bottle to the charge/vent adapter. Connect a #8M vent adapter into the #8F charge / vent adapter. Purge helium gas line. Remove #8M vent adapter from the helium gas charging line.

4.34 Connect the helium gas charging line with charge / vent adapter to the cryocooler gas SUPPLY coupling.

4.35 Connect a second charge / vent adapter to the RETURN coupling of the cryocooler.

4.36 Connect the expander cable to the replacement cryocooler valve motor receptacle.

4.37 Charge cryocooler with helium gas to 1.4 Mpa (14 Kg/cm²G). Start the compressor. While the cryostat is running, vent gas to 0.04 Mpa (0.4 Kg/cm²G). Charge, run and vent the cryocooler 10 times. Stop compressor. Charge the cryocooler to 1.95 Mpa

(19.5 kg/cm²G) equalization pressure.

4.38 Remove the charge / vent adapter from the cryocooler.

4.39 Connect the SUPPLY and RETURN gas lines to the cryocooler.

4.40 Leak check the cryocooler using Snoop.

4.41 Check the system equalization pressure. If necessary, and or vent gas at the compressor.

4.42 Start cryocooler system.

4.43 Reassemble the used displacer, valve stem, valve disc, and valve motor assembly into the transport cylinder.

4.44 Put away maintenance tools.

4.45 Check the operating condition of the cryocooler system after startup and 2 hours later. Record the following measurements;

- * ETM(operating hours)
- * Gas supply and return pressure at the compressor
- * Gas supply and return temperature at the cryocooler
- * Cooling water supply and return temperature
- * Ambient temperature
- * Electrical voltage and operating current
- * 4x 4K temperatures. See step 5.
- * 4x 40K temperatures . See step 5.

5.0 PROCEDURE FOR MEASURING TEMPERATURES ON ASC'S MAG600 MAGNET

The MAG600 magnet is installed with 8 temperature sensors. All(4)temperature sensors on the 40K shield use Platinum Resister temperature sensors. From magnet #16 on, all(4) temperature sensors on the 4K coils use SI R90 Ruthenium Oxide sensors. All sensors have a 10 μ A excitation current.

5.1 Connect the two instrumentation cables from ASC's mobile magnet power supply to the bottom face of the vacuum enclosure housing where the cryocooler is located on the magnet. Instrumentation cable #1 connects to the receptacle labeled #1 and cable #2 connects to the receptacle labeled #2.

5.2 Determine whether the digital multimeter in the magnet power supply is a Fluke or Omega multimeter, then set the multimeter to the correct scale.

For Omega meter:

⚠ [at 4K measuring] Push "OHM/4W", then push "↑ ↓" keys until $\pm XXXX.XX$ is displayed.

⚠ [at 40K measuring] Push "OHM/4W", then push "↑ ↓" keys until $\pm XXX.XXX$ is displayed.

For a Fluke meter:

⚠ [at 4K measuring] Push "KO/4 wire", then press "2000" key, until $\pm XXXX.XX$ is displayed.

⚠ [at 40K measuring] Push "KO/4 wire", then press "200" key, until $\pm XXX.XXX$ is displayed.

5.3 Set the toggle switch on the power supply instrumentation panel to choose between measuring the 4 and 40K temperature sensors, Use the separate selector switches to read the different 4 and 40K temperatures. For each temperature sensor, record the resistance output on the digital multimeter.

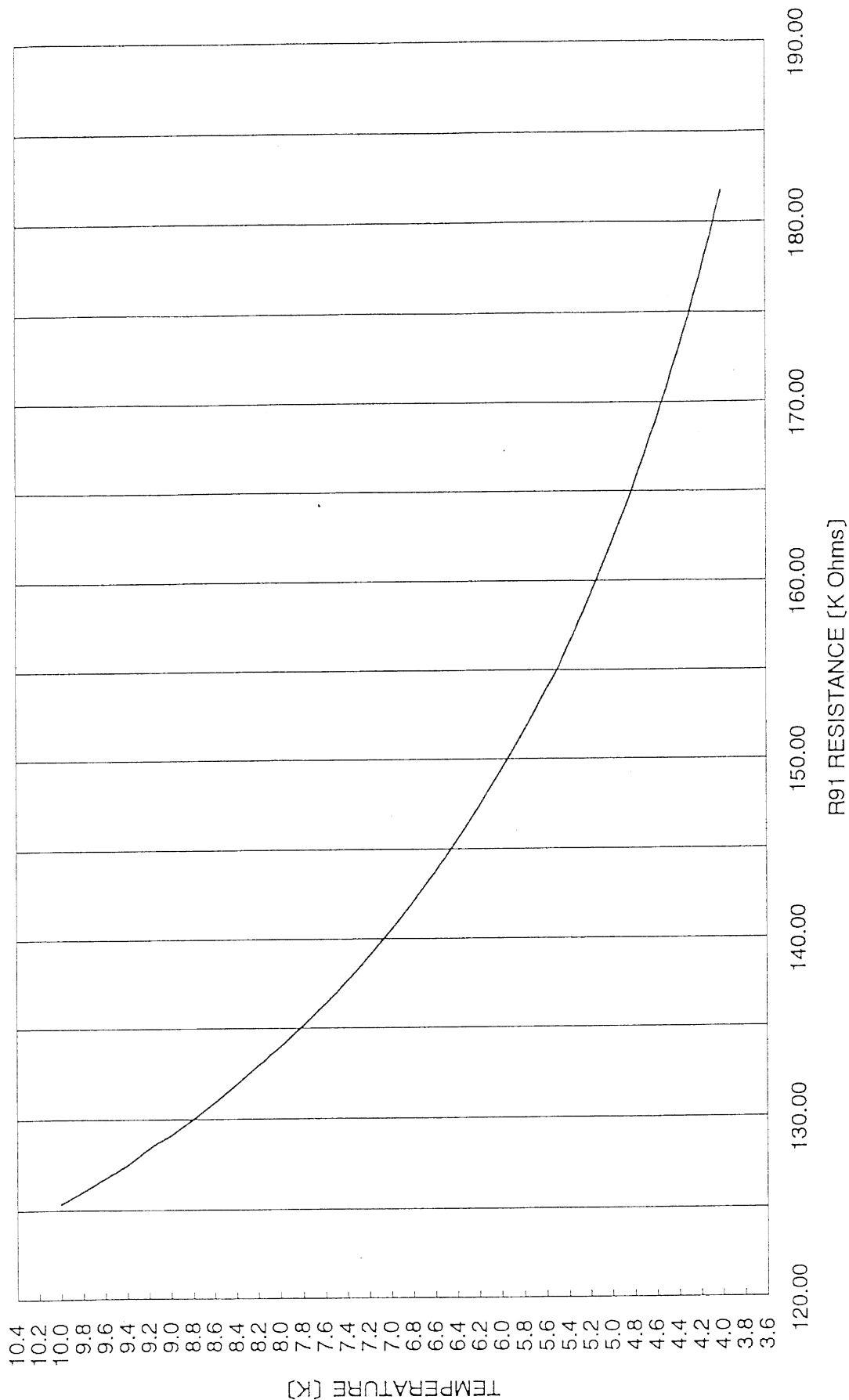
5.4 See the attached calibration curves for each temperature sensor to convert the resistance reading into degrees Kelvin.

⚠	Position	4K Temperature Sensor Location	Sensor Type	Calibration Curve
	1	at 4K heat station interface	R91	Page 9
	2	at 4K plate	R91	Page 9
	3	Upper Coil	R91	Page 9
	4	Lower Coil	R91	Page 9

Position	40K Temperature Sensor Location	Sensor Type	Calibration Curve
1	at 40K heat station interface	Platinum Resistor	page 10
2	at 40K plate	Platinum Resistor	Page 10
3	Upper shield	Platinum Resistor	Page 10
4	Lower shield	Platinum Resistor	Page 10

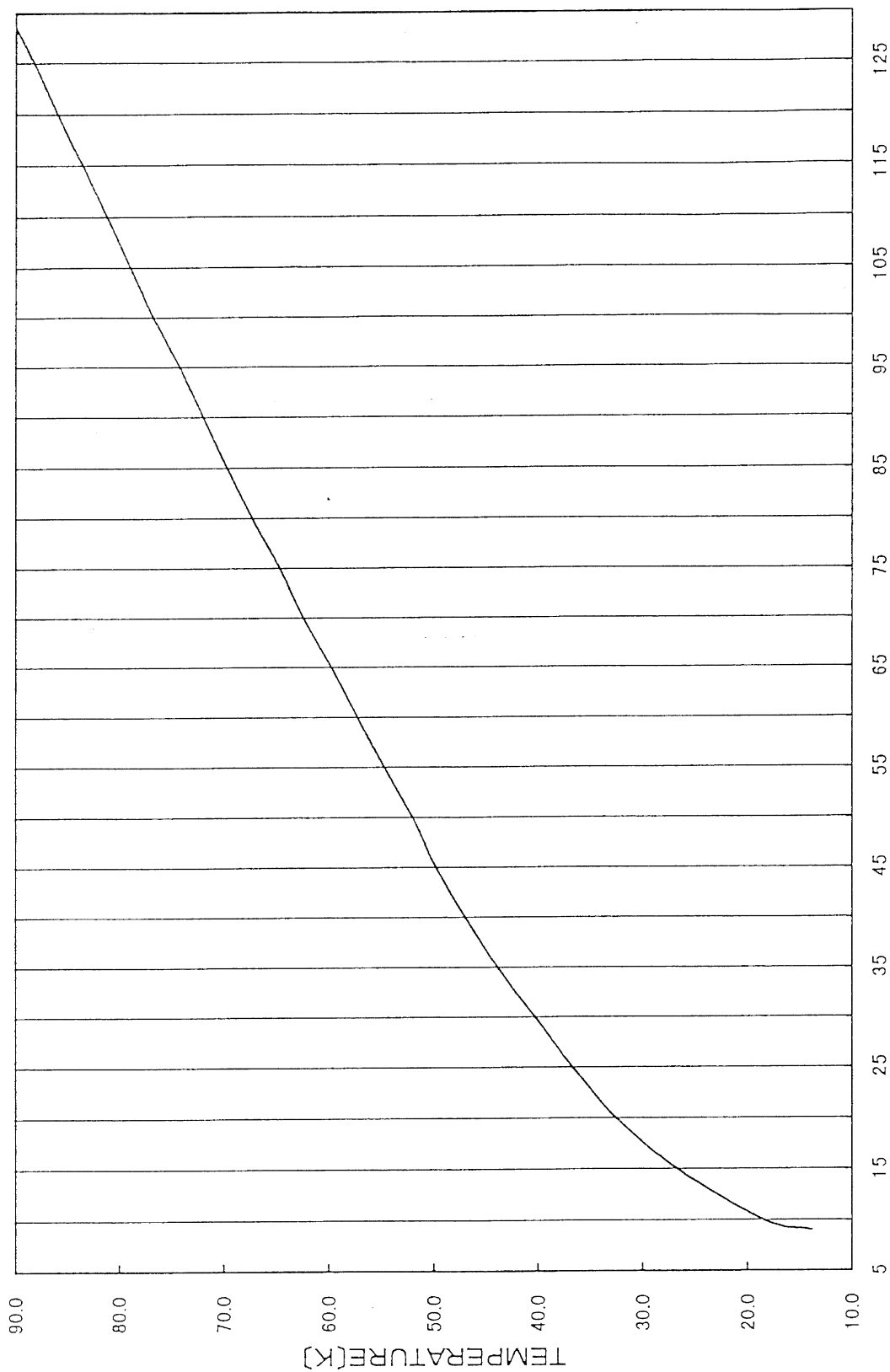
RUTHENIUM OXIDE R91 TEMPERATURE SENSOR CALIBRATION CURVE

A



ASC OPART MAGNET
RUTHENIUM OXIDE TEMPERATURE SENSORS (R91)
EXCITATION CURRENT 1 μ A

PLATINIUM RESISTOR TEMPERATURE CALIBRATION CURVE



RESISTANCE[Ohms]

ASC OPART MAGNET
SI PLATINIUM RESISTOR TEMPERATURE SENSORS
EXCITATION CURRENT 10 μ A

2700645A
page 7 of 8
RBS 5/97

TEMP-CAL-PLATINIUM-ASC.XLS



{2} HOSE JOINT CONNECTING AND DISCONNECTING PROCEDURE

1 . Connecting hose joint

- 1.1) Remove the cap and plug from the couplings.
- 1.2) Clean the couplings to remove any contaminants.
- 1.3) Verify that the gasket is in the male coupling.
- 1.4) To mate the female coupling of the hose with the male coupling , turn the union nut of female coupling by hand. Then turn the union nut with the 1-3/16" wrench with holding the body of the female-coupling of the hose with the 1" wrench.
Continue to turn the union nut until it becomes tight.
Do not tighten the nut completely with tis condition.

- 1.5) Hold the body of the male coupling with the 1-1/8" wrench or an adjustable wrench that is not included in the accessory.

Tighten the union nut of the female coupling with the 1-3/16" wrench.

Warning : Do not tighten the union nut without holding the body of the male coupling.

The piping of the manifold may be bent or the male coupling screw and the expander body screw may be broken, if the union nut is tightened without holding the body of the male coupling.

Warning : Do not use an adjustable wrench for tightening the union nut of the female coupling. The nut may be over tightened if an adjustable wrench is used.

2 . Disconnecting hose joint

- 2.1) Hold the body of the male coupling with the 1-1/8" wrench or an adjustable wrench that is not included in the accessory. Turn the union nut of the female coupling about 1/8 turn to break the connection.
- 2.2) Turn the union nut with the 1-3/16" wrench with holding the body of the female coupling of the hose with the 1" wrench. Continue to unscrew the union nut.
- 2.3) Put the cap and plug on the couplings.

Warning : Do not Loosen the union nut without holding the body of the male coupling.

The piping of the manifold may be bent or the male coupling may be loosened, if the union nut is loosened without holding the body of the male coupling.

Refer to the drawings of next page < A-12 > .